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Industrial trucks — Fork arm extensions and telescopic fork arms — Technical characteristics and strength requirements

Chariots de manutention — Extensions de bras de fourche et bras de fourche télescopiques — Caractéristiques techniques et prescriptions de résistance

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 110, *Industrial trucks*, Subcommittee SC 2, *Safety of powered industrial trucks*.

This second edition cancels and replaces the first edition (ISO 13284:2003), which has been technically revised.

The main changes are as follows:

— SI units have been adopted throughout;

— safety factor has been aligned with ISO 2330:2002

— the requirements for information for use have been revised; including a clarification of tip loading.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document was developed in response to worldwide demand for specifications for fork arm extensions and telescopic fork arms.

Fork arm extensions are used as an economic means of extending the effective blade length of fork arms on industrial trucks. They are available with either a closed rectangular cross-section or an open inverted-channel cross-section.

Where possible, preference should be given to using a longer fork rather than an extension. If extensions are to be used, preference should be given to the closed cross-section rather than an open type of extension.

Telescopic fork arms replace standard fork arms and provide the truck operator with the means of adjusting the fork arm blade length. They are available either as simple variable-length fork arms for handling loads of varying dimensions or, alternatively, for reaching out or retracting palletized loads in double-deep stacking and de-stacking operations.

Industrial trucks — Fork arm extensions and telescopic fork arms — Technical characteristics and strength requirements

1 Scope

This document specifies technical characteristics and strength requirements for fork arm extensions and telescopic fork arms for industrial trucks. It applies to fork arm extensions and telescopic fork arms, as defined in ISO 5053-2, designed for use on industrial trucks and stacking lift trucks, as defined in ISO 5053-1, having fork arm carriers and, in the case of fork arm extensions, fork arms conforming to ISO 2330.

This document does not apply to integral transverse telescopic fork devices or scissor-action reach devices.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3691-1, *Industrial trucks — Safety requirements and verification — Part 1: Self-propelled industrial trucks, other than driverless trucks, variable-reach trucks and burden-carrier trucks*

ISO 3691-2, *Industrial trucks — Safety requirements and verification — Part 2: Self-propelled variable-reach trucks*

ISO 2330:2002, *Fork-lift trucks — Fork arms — Technical characteristics and testing*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
parent fork arm
fork arm having the rated capacity at the rated load centre distance, blade length and blade cross-section for which a fork arm extension is specifically designed

3.2
test load
F_{EX} and F_T applied load for verifying the strength of fork arm extension and telescopic fork arms, respectively, by physical testing or calculation

4 Symbols

b Fork arm blade width (mm)

C	Rated capacity of each parent fork arm (kg)
C_E	Rated capacity of each fork arm extension (kg)
C_R	Rated capacity of each telescopic fork arm in the fully retracted mode (kg)
$C_{R\text{-}EXT}$	Rated capacity for each telescopic fork arm in the fully extended mode (kg)
D	Rated load centre distance of each parent fork arm (mm)
D_E	Rated load centre distance of each fork arm extension (mm)
D_R	Rated load centre distance of each telescopic fork arm in the fully retracted mode (mm)
$D_{R\text{-}EXT}$	Rated load centre distance for each telescopic fork arm in the fully extended mode (mm)
F_{EX}	Test/design load for open- and closed-section extensions (N)
F_T	Test/design load for telescopic fork arms (N)
l	Blade length of the parent fork arm or of the fully retracted telescopic arm (mm)
l_1	Blade length of the fork arm extension or of the fully extended telescopic arm (mm)
l_2	$= 0{,}9\ l_1 - l$ (mm)
M	Stress modulator
R	Safety factor, as specified in 6.1 of ISO 2330:2002
S	Total lateral clearance between the parent fork and the fork arm extension (mm)
Y_a	Actual material yield strength of extension material (MPa)
Y_m	Minimum specified material yield strength of extension material (MPa)
Z	Section modulus of the extension of the fork-arm tip (mm^3)
σ	Buckling strength in the fork-arm extension (MPa)
g	Acceleration due to gravity (9,8 m/s^{-2})

5 Requirements for rated capacity and rated load centre distance

5.1 Fork arm

The rated capacity (C) and rated load centre distance (D) for the parent fork arm of quantity production shall conform with ISO 3691-1 and ISO 3691-2. For rated capacities of 5 500 kg and above, the rated load centre distance shall be as specified in ISO 3691-1.

5.2 Fork arm extension

The rated capacity (C_E) and rated load centre distance (D_E) for each fork arm extension shall be proportional to the rated capacity (C) and rated load centre distance (D) for the parent fork arm, as given in Formula (1):

$$C_E \leq \frac{C \cdot D}{D_E} \tag{1}$$

5.3 Telescopic fork arm

The rated capacity (C_R) and rated load centre distance (D_R) for each telescopic fork arm shall both be as specified in ISO 3691-1and ISO 3691-2, in kilograms and millimetres respectively, when the telescopic fork arm is in the fully retracted mode.

In extended mode, the rated capacity and load centre distance shall be specified by the manufacturer.

6 Requirements for fork arm extensions

6.1 Length

The blade length l of the parent fork arm for open-section and closed-section fork arm extensions shall conform to the following Formulae (2) and (3):

$$l \geq 750 \text{ mm} \tag{2}$$

$$l \geq 0{,}6 \cdot l_1 \tag{3}$$

where l_1 is the blade length of the fork arm extension.

NOTE Subject to a risk assessment, extensions beyond this limit can be agreed between the industrial truck manufacturer or fork arm manufacturer and the user; and marked accordingly.

6.2 Accidental disengagement

Fork arm extensions shall be designed to prevent accidental disengagement from the parent fork arm.

6.3 Yield strength and Safety factor

To determine the actual yield strength of the material which has been used to manufacture a fork arm extension, it is necessary to have a tensile test result from a sample of that material. Prior to testing the extensions, an equivalent sample shall be tensile tested. The resulting yield strength value, Y_a, shall be compared to the minimum yield strength specified for the material used, Y_m. This factor shall be used to increase the test load to ensure that a minimum yield strength material will provide the safety factor R in accordance with 6.4.

If the value of Y_a cannot be determined, then apply $Y_a/Y_m = 1{,}8$, in Formula 4

6.4 Test / design load

For open-section and closed-section fork arm extensions, a test load $0{,}5F_{Ex}$ shall be applied as shown in Figure 1, and Formula (4):

See Clause 8 for the specific testing details and requirement.

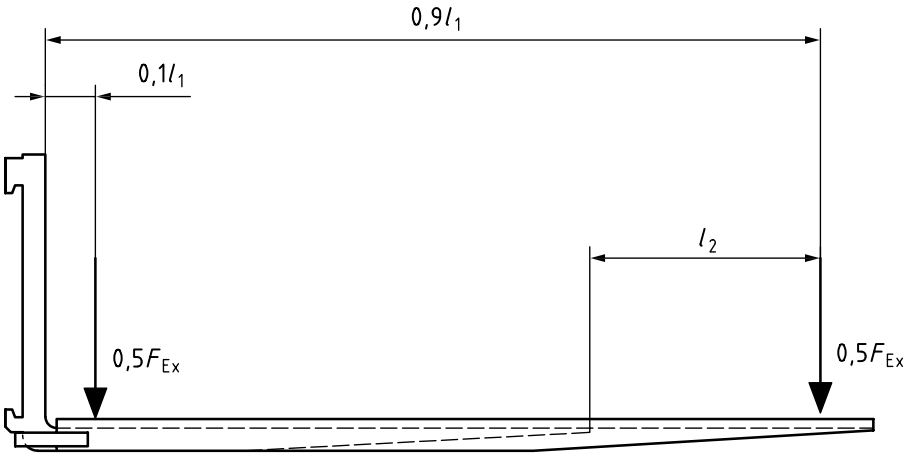


Figure 1 — Test/design load (applied twice) for open-section and closed-section fork-arm extensions

$$F_{EX} = \frac{g \cdot R \cdot C_E \cdot D_E \cdot Y_a}{0{,}5 \cdot l_1 \cdot Y_m} \tag{4}$$

NOTE The diagram is based on twin point loading. The load $0{,}5F_{EX}$ applied at $0{,}1l_1$ is optional during testing and does not affect the result.

6.5 Open-section fork arm extension retaining system

For open-section fork arm extensions, the strength of the retaining system specified in 6.2 shall sustain the test/design load $0{,}5F_{EX}$ shown in Figure 2.

The extension retaining device shall limit the vertical movement of the fork arm extension, at the heel end, to 20 mm, and shall show no permanent deformation.

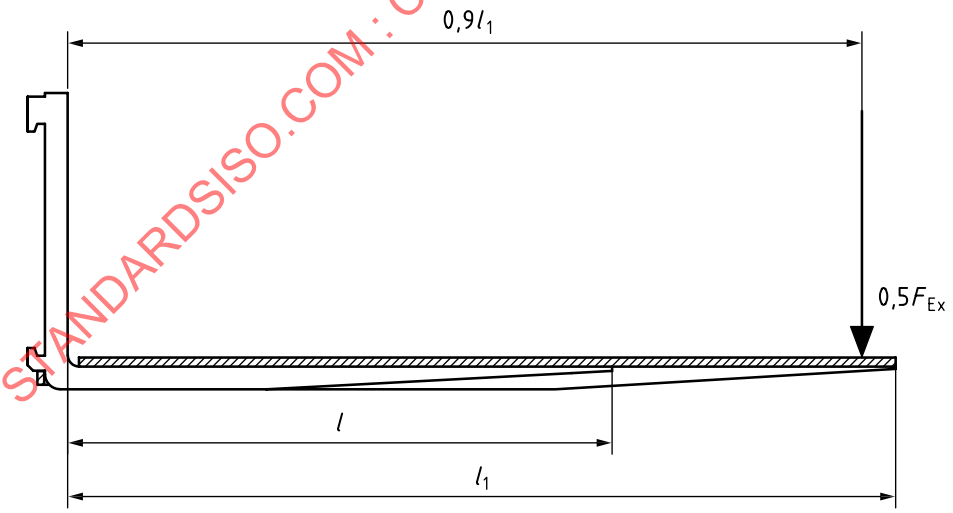
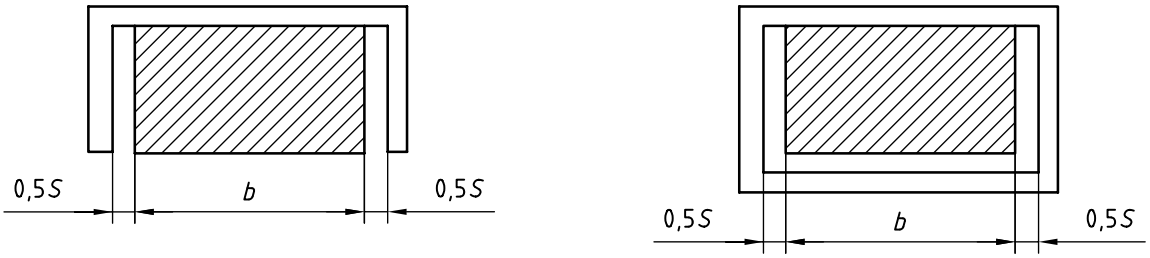


Figure 2 — Test/design load for open-section fork arms

6.6 Lateral clearance

Lateral clearance between the fork arm extension and parent fork arm shall satisfy the following requirement.

The total lateral clearance S shall not exceed 0,1 times the blade width b, and shall be not more than 10 mm. This is shown in Figure 3 a) and b):



a) Open section **b) Closed section**

Figure 3 — Fork arm extensions

7 Requirements for telescopic fork arms

7.1 Strength

The strength of telescopic fork arms in the retracted position, using a safety factor of R, shall satisfy the requirements of 7.2.

The strength of the extended portion of telescopic fork arms in the extended position, using a safety factor of R, shall satisfy the requirements of 7.3.

7.2 Test load in fully retracted mode

For telescopic fork arms in the fully retracted mode, the test/design load F_T shall be applied as shown in Figure 4, and Formula (5):

$$F_T = g \cdot R \cdot C_R \tag{5}$$

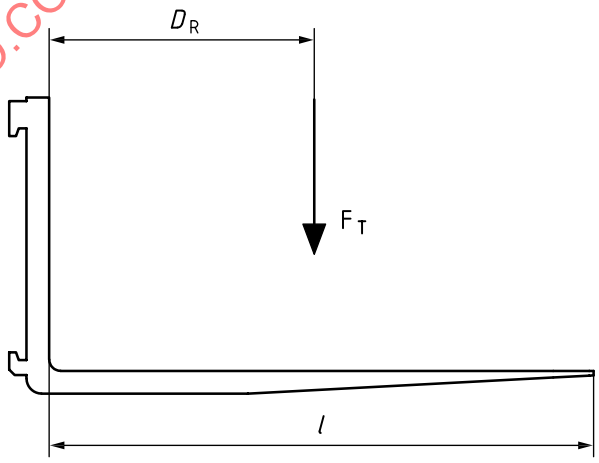


Figure 4 — Test/design load for telescopic fork arms in the fully retracted mode

7.3 Test load in fully extended mode

For telescopic arms in the fully extended mode, the test/design load F_T shall be applied as shown in Figure 5, and Formula (6):

$$F_T = \frac{g \cdot R \cdot C_{R-EXT} \cdot D_{R-EXT} \cdot Y_a}{0,9 \cdot l_1 \cdot Y_m} \quad (6)$$

Where $D_{R\text{-}EXT}$ is normally 0,5 l_1

If the value of Y_a cannot be determined, then apply Y_a/Y_m = 1,8, in Formula (6).

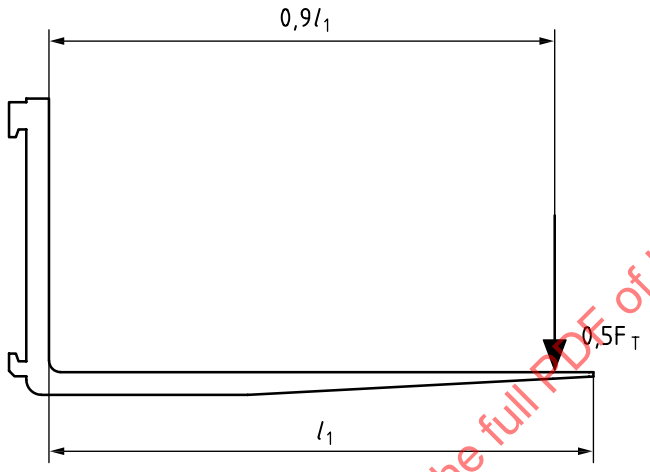


Figure 5 — Test/design load for telescopic fork arms in the fully extended mode

8 Verification and Testing

8.1 General

The strength requirements of Clauses 6 and 7 shall be verified, either

a) by calculation, to show that load F_{EX} or F_T does not produce stresses in excess of the yield strength of the component parts, or

b) by physical testing.

In the latter case, the procedure indicated in 8.3 shall be followed and the requirements of 8.4 satisfied.

8.2 Buckling in fork arm extensions

Calculation for fork extensions shall include assessment of the buckling strength. This may be achieved using the Formula (7)

$$\sigma = \frac{0,5 \cdot F_{EX} \cdot l_2}{Z \cdot M} \quad (7)$$

NOTE 1 M is a stress modulator which is ≤ 1 and usually between 0,4 and 0,8, depending upon the material thickness and the design parameters.

NOTE 2 The modulator is required due to the buckling which promotes stresses higher than calculated using the standard formulae. The value of the modulator can be determined by comparing the actual load required to promote yielding to the theoretical load.